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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

CHEN, KIN CHAN

ART UNIT PAPER NUMBER

1765

DATE MAILED: 02/21/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/473,391

Applicant(s)

CADIEN ET AL.

Examiner

Kin-Chan Chen

Art Unit

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 February 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-8, 10-12, 14, 24 and 25 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-8, 10-12, 14, 24 and 25 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

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DETAILED ACTION

Claim Objections

1. Claim 12 is objected to because of the following informalities:

In claim 12, line 2, "is comprises" should be --comprises--.

Appropriate correction is required.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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4. Claims 1, 2, 8, 11, and 12 are rejected under 35 U.S.C. 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Aoki et al. (US 6,387,190; hereinafter "Aoki").

Aoki teaches that a dielectric layer may be formed over a substrate. The dielectric layer may have trenches therein. A barrier may be formed in the trenches and on a top surface of the dielectric layer. Metal may be deposited over the barrier. The metal (such as copper) may be polished with a slurry (chemical mechanical polishing). The slurry includes an abrasive which may comprise iron. Dielectric layer may comprise an oxide of silicon. The barrier is electrically conductive, such as tantalum (it reads on the limitation of claims 2 and 12). See col. 4, lines 18-51.

The instantly claimed invention differs from Aoki by specifying the slurry may include an abrasive harder than the metal and less harder than the barrier. But because the same materials are used with the same process steps, it would inherently contain the same properties and functions as claimed, the abrasive harder than the metal (such as copper) and less harder than the barrier (such as tantalum).

5. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (US 6,387,190; hereinafter "Aoki").

Aoki teaches that a dielectric layer may be formed over a substrate. The dielectric layer may have trenches therein. A barrier may be formed in the trenches and on a top surface of the dielectric layer. Metal may be deposited over the barrier. The metal (such as copper) may be polished with a slurry. The slurry includes an abrasive which may comprise iron. Dielectric layer may comprise an oxide of silicon. The barrier

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is electrically conductive, such as tantalum. See col. 4, lines 18-51. The instantly claimed invention differs from Aoki by specifying the slurry may include an abrasive harder than the metal and less harder than the barrier. But because the same materials are used with the same process steps, it would inherently contain the same properties and functions as claimed, the abrasive harder than the metal (such as copper) and less harder than the barrier (such as tantalum).

Aoki does not teach that the dielectric layer may be SiOF (fluorinated silicon oxide). It is a conventional dielectric. Hence, it would have been obvious to one skilled in the art at the time of invention to use conventional dielectric SiOF in Aoki process in order to provide their art recognized advantages and produce an expected result. See Boeck et al. (US 5,880,018) in the record as evidence.

6. Claims 24 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Aoki et al. (US 6,387,190; hereinafter "Aoki") in view of admitted prior art.

Aoki teaches that a dielectric layer may be formed over a substrate. The dielectric layer may have trenches therein. A barrier may be formed in the trenches and on a top surface of the dielectric layer. Metal may be deposited over the barrier. The metal (such as copper) may be polished with a slurry. The slurry includes an abrasive which may comprise iron. Dielectric layer may comprise an oxide of silicon. The barrier is electrically conductive, such as tantalum. See col. 4, lines 18-51. The instantly claimed invention differs from Aoki by specifying the slurry may include an abrasive harder than the metal and less harder than the barrier. But because the same materials

are used with the same process steps, it would inherently contain the same properties and functions as claimed, the abrasive harder than the metal (such as copper) and less harder than the barrier (such as tantalum).

Aoki is not particular about the copper interconnect structure, therefore, it would have been obvious to one with ordinary skill in the art to use it for forming a damascene structure because it is one of the most popular and well-known structure in the art of semiconductor device fabrication. The admitted prior (page 3 of the specification) is relied on to show the well-known structure. Hence, it would have been obvious to one with ordinary skill in the art to modify Aoki by incorporating said damascene structure in order to provide their art recognized advantages and produce an expected result. Also see Avanzino et al. (US 6,140,239; col. 1) as evidence of well-known damascene structure.

As to dependent claim 25, the combined prior art does not teach that the dielectric layer may be SiOF (fluorinated silicon oxide). It is a conventional dielectric. Hence, it would have been obvious to one skilled in the art at the time of invention to use conventional dielectric SiOF in the process of the combined prior art in order to provide their art recognized advantages and produce an expected result. See Boeck et al. (US 5,880,018) in the record as evidence.

7. Claims 1, 2, 4-8, 10-12, 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Avanzino et al. (US 6,140,239 ; hereinafter "Avanzino") in view of Aoki et al. (US 6,387,190; hereinafter "Aoki").

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Avanzino teaches that a dielectric layer may be formed over a substrate (or forming a damascene structure). The dielectric layer may have trenches therein. A barrier may be formed in the trenches and on a top surface of the dielectric layer. Metal may be deposited over the barrier. The metal (such as copper) may be polished (chemical mechanical polishing) with a slurry. The slurry includes an abrasive which may comprise iron oxide. Dielectric layer may comprise an oxide of silicon. The barrier is electrically conductive, such as tantalum (see col. 4, lines 10-51).

Unlike the claimed invention, Avanzino does not teach an abrasive which may comprise iron. In a method of polishing copper structure in semiconductor device fabrication, Aoki teaches polishing copper structure using slurry. The slurry includes an abrasive which may comprise iron. Hence, it would have been obvious to one with ordinary skill in the art to modify Avanzino by adding iron of Aoki to the slurry because they are being used in the same manner and for the same purpose of polishing copper structure in semiconductor device fabrication.

The instantly claimed invention differs from the combined prior art by specifying the slurry may include an abrasive harder than the metal and less harder than the barrier. But because the same materials are used with the same process steps, it would inherently contain the same properties and functions as claimed, the abrasive harder than the metal (such as copper) and less harder than the barrier (such as tantalum).

The limitations of claims 1, 2, 8, 11, and 12 have been addressed above.

As to dependent claim 4, the abrasive has a Moh's hardness between approximately 3.5 and 6. As to dependent claims 6 and 14, the slurry contains approximately 0.5% to 10% by weight of the abrasive. As to dependent claim 7, the slurry contains an oxidizer comprising H_2O_2 (see col. 4, lines 10-12, 23-28, 41-51)

As to dependent claims 5 and 10, the combined prior art does not specify the pH value of slurry used in the process. However, it is conventional and obvious to dilute the slurry with weak acid or alkali to adjust pH value of slurry to between 3.5 to 7 in order to provide their art recognized advantages and produce an expected result because same is a well-known result-effective variable.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Boeck et al. (US 5,880,018) teach the conventional SiOF (see col. 7, lines 36). The reference was cited in Paper No. 8.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kin-Chan Chen whose telephone number is (703) 305-0222. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on (703) 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final

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communications. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-2934.

K. C. Chen

K-C C
February 14, 2003

Patent Examiner
Group Art Unit 1765